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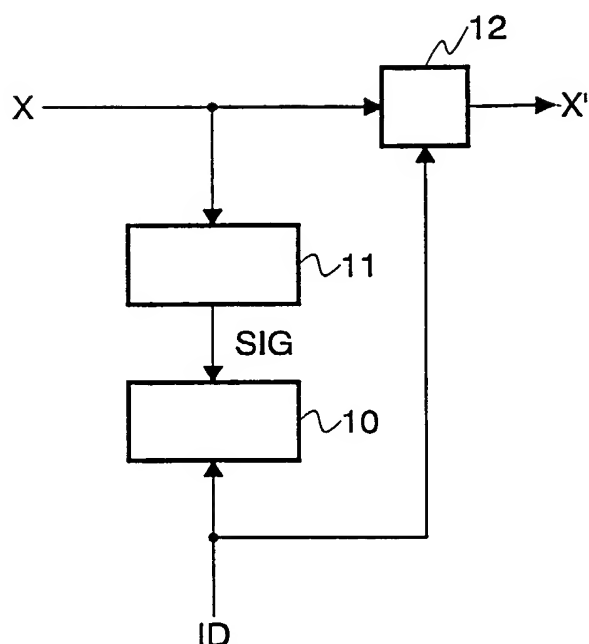
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(54) Title: MULTIMEDIA MONITORING BY COMBINING WATERMARKING AND CHARACTERISTIC SIGNATURE OF SIGNAL



(57) Abstract: A method and arrangement are disclosed for distributing multimedia content such that that the actual distribution of said content can be monitored in an efficient and reliable manner. The invention combines the extensiveness of feature extraction and the robustness of watermarking. Characteristic features of the content, e.g. luminance distribution, are extracted (11) to constitute a signature (SIG) of the content. In addition, a watermark is embedded (12) having a payload representing an index (ID) in a database (10) in which the content to be monitored is stored. The watermark serves as an index for limiting the database search needed for monitoring the signatures.



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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

MULTIMEDIA MONITORING BY COMBINING WATERMARKING AND CHARACTERISTIC  
SIGNATURE OF SIGNAL

## FIELD OF THE INVENTION

The invention relates to a method and a system for distributing media content such as audio and/or video programs. The invention also relates to a method and a system for monitoring the distribution of such media content.

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## BACKGROUND OF THE INVENTION

Producers of audiovisual content, such as television broadcasters or advertisers, are often interested in having knowledge as to whether, where and when their work is distributed. To this end, "broadcast monitoring" systems have been developed recently.

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In one known broadcast monitoring method, sometimes referred to as active monitoring, a watermark is embedded in the video content. The payload in the watermark is a pointer to a database entry corresponding to the video sequence (e.g. a clip, a movie scene, a commercial). The watermark is retrieved and used to identify the content. A problem of this method is that a large payload is necessary for exploiting a large database. Such a large payload is difficult to embed in an imperceptible and unobtrusive manner.

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In another known broadcast monitoring method, referred to as passive monitoring, so-called robust features are extracted from the content. Robust features are variables computed from the content, which remain more or less unchanged as long as the scene does not change too much. For every scene there is a unique set of robust features. For example, video pictures are divided into blocks. Each block is represented by a bit indicating whether the luminance of said block is higher or lower than a given reference value (e.g. the luminance of the neighboring block). The bit string corresponding to the robust features is then used as a signature for the particular scene in the database. A problem of this method is that the bit string extracted at the monitoring end may be slightly different from the signature in the database. This makes it difficult to search the signature in the database which most closely resembles the extracted bit string. Moreover, the signature is not necessarily unique.

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## OBJECT AND SUMMARY OF THE INVENTION

It is an object of the invention to improve the robustness and efficiency of content monitoring.

To this end, the invention provides a method and a system for distributing  
5 media content and for monitoring said media content as defined in the appended claims.

The current invention is an inventive combination of the prior-art schemes. The media content is watermarked with a relatively small payload giving information on that section of the database in which the content is to be searched. The robust signature is then used for a search within said section. The embedded watermark thus serves as an index for  
10 restricting the database search. It is achieved with the invention that the embedded watermark can be relatively small and thus robust. At the same time, the database search problem is reduced in complexity.

For example, the database may contain scenes of a large number of movies. The watermark indicates which movie a given scene belongs to. The extracted signature is  
15 then used to find the particular scene from that movie.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a schematic diagram of a system for distributing media content in accordance with the invention.

20 Fig. 2 shows a schematic diagram of a system for monitoring the distribution of said media content in accordance with the invention.

## DESCRIPTION OF EMBODIMENTS

In Fig. 1, a signal X represents media content, for example, a video scene. The  
25 video scene may be a particular news item produced by the BBC, or a commercial of company A. The BBC wants to trace broadcasts of its news item by other broadcasters. Company A wants to check whether its expensive commercial has indeed been broadcast at prime time through the TV stations of network B. Similar considerations apply to other distribution networks such as the Internet.

30 At the distribution end the system comprises a database 10, a feature extractor 11, and a watermark embedder 12. The feature extractor 11 extracts a signature SIG from the actual video content. For example, the video pictures are divided into blocks. Each block is represented by a bit indicating whether the luminance of said block is higher or lower than the luminance of the neighboring block. However, it will be appreciated that an infinite

number of alternative embodiments of feature extractor **11** can be designed by a person skilled in the art. Similar features can be extracted from an audio signal, for example, a digitized version of the actual frequency spectrum.

The bit string thus generated by the feature extractor **11** constitutes a signature  
5 SIG. The signature SIG is applied to the database **10** and stored in a field of a record corresponding to the news item or commercial. The relevant record in the database is given a unique ID. Said ID is applied to the watermark embedder **12** and encoded as payload of a watermark. An example of such a watermark embedder having the capability to convey a multi-bit payload is disclosed in International Patent Application WO 99/45705. The  
10 watermarked content X' is then broadcast or otherwise distributed.

The arrangement shown in Fig. 2 monitors the relevant distribution channel. It receives the content X' and comprises a watermark detector **21** and a feature extractor **22**. The arrangement is coupled to the database **10**. Note that this is not necessarily a real-time connection. The watermark detector **21** detects the embedded watermark and, if the  
15 watermark is found, decodes its payload ID. An example is disclosed in International Patent Application WO 99/45705. The feature extractor **22** performs the same operation as feature extractor **11** in Fig. 1. It will be appreciated that the extractor is designed in such a way that the robust features of the content are not affected by the embedded watermark.

The decoded watermark payload ID and the signature SIG are applied to the  
20 database. Because the watermark provides a reliable data channel, the decoded payload may be assumed to be identical to the ID embedded by the arrangement which is shown in Fig. 1. The search for the signature SIG in the database (or the search for a closely resembling signature in view of possible changes caused by processing and transmission) can be limited to those records having the relevant ID. In database terminology: the ID serves as an index  
25 for limiting the database search.

A method and arrangement are disclosed for distributing multimedia content such that the actual distribution of said content can be monitored in an efficient and reliable manner. The invention combines the extensiveness of feature extraction and the robustness of watermarking. Characteristic features of the content, e.g. luminance distribution, are  
30 extracted (11) to constitute a signature (SIG) of the content. In addition, a watermark is embedded (12) having a payload representing an index (ID) in a database (10) in which the content to be monitored is stored. The watermark serves as an index for limiting the database search needed for monitoring the signatures.

## CLAIMS:

1. A method of distributing media content, comprising the steps of extracting features of said media content, storing a signature representing said features in a section of a database, embedding a watermark in said media content indicative of said section of the database, and distributing the watermarked media content.

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2. A method of monitoring distribution of media content, comprising the steps of receiving said media content, detecting a watermark in said media content indicative of a section of a database, extracting features of said media content, and searching a signature representing said features in said section of the database.

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3. A system for distributing media content, comprising means for extracting features of said media content, means for storing a signature representing said features in a section of a database, means for embedding a watermark in said media content indicative of said section of the database, and means for distributing the watermarked media content.

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4. A system for monitoring distribution of media content, comprising means for receiving said media content, means for detecting a watermark in said media content indicative of a section of a database, means for extracting features of said media content, and means for searching a signature representing said features in said section of the database.

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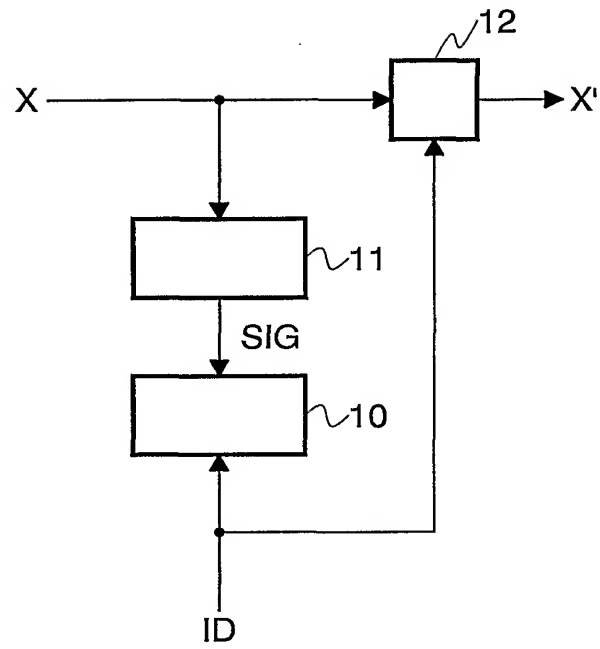


FIG.1

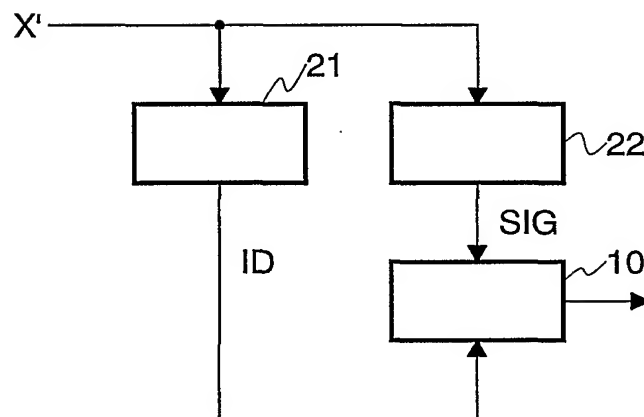


FIG.2

## INTERNATIONAL SEARCH REPORT

International Application No

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## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04H1/00 H04H9/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 5 481 294 A (THOMAS WILLIAM L ET AL) 2 January 1996 (1996-01-02) the whole document ----	1-4
X	WO 99 59275 A (NIELSEN MEDIA RESEARCH INC) 18 November 1999 (1999-11-18) page 13, line 1-14 page 21, line 12 -page 27, line 15; claim 48; figure 2 ----	1-4
A	WO 99 45705 A (KALKER ANTONIUS A C M ;KONINKL PHILIPS ELECTRONICS NV (NL); PHILIP) 10 September 1999 (1999-09-10) cited in the application the whole document -----	1-4



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
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- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

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Information on patent family members

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